ALARA IMPLEMENTATION AT UKRAINIAN NPPs

T. Lisova, Nuclear Energy Department, Ministry of Fuel and Energy of Ukraine.
Y. Roshchyn, National Nuclear Energy Generation Company "Energoatom", Ukraine.

Introduction

Work Management Principles utilization in the nuclear industry leads to harmful influence decreasing that means decreasing occupational dose exposure. The decrease of occupational dose exposure is often reached by means of decreasing the number of workers in the control zone, reducing the working time, reducing the amount of error correction work during different stages of operation. At that the objective of costs reduction as well as outage time minimization can be reached that leads to increasing electricity production (generation).

ALARA activity is based on following principles:

- Any exposure will be justified if a prospective benefit is higher than a potential risk of exposure;
- Exposure must be held at a minimal possible level, in view of all social and economic conditions;
- Exposure must be restricted by limits established by rules and instructions in order to minimize the exposure risk.

ALARA Implementation in the National Nuclear Energy Generation Company "EnergoAtom"

Following the above principles the utility organization NNEGC "Energoatom" for 5 years have been carrying out systemic work in the field of radiation protection and radiation safety. In 2000-2001 Radiation Protection groups/ALARA groups were created at all Ukrainian NPPs. Regulations (sets of rules, instructions) were issued at each NPP in order to manage radiation-dangerous jobs and manage radiation protection in general.

ALARA groups functions:

- carrying out analysis and work planning with the purpose of achieving the highest possible personnel dose reduction and not exceeding the individual effective dose exposure of more than 20mSv /year;
- Putting into practice such organization of labor and method of work performance in "a stringent operation condition zone" when exceeding dose limits isn't practically possible as prescribed by a job instructions for these procedures; and when all personnel in a work management link (head of division – head of section - foreman- superintendent of work –member of crew) are understanding and realizing their personal responsibilities and duties while performing such particular jobs.
- ALARA Program acceptance and review;
- establishing and approval of annual exposure indicators;
- preparation, consideration and approval of annual and prospective measures to decrease exposure and increase radiation protection level;
- consideration during their meetings of ALARA Program performance, collective dose level and decision-making to improve the program's efficiency;
- preparing information (data) in order to approve the doses planned for NPPs as a whole for a year, for a planned unit outage, for separate divisions, and if necessary – for the most dangerous jobs;

- analysis of repair documents, job programs, safety aids, maintenance regulation with regards to adequacy of radiation protection measures, measures performance control.

- analysis of prospective works during unit outage, radioactive-dangerous jobs specifying, outage documentation checking for the purpose of organizational and technical evolutions to ensure not exceeding of the planned dose exposure for these jobs and development of measures for decreasing dose exposure;

- analysis of dose exposure for the accounting period (quarterly, if necessary – monthly) for units, divisions, for separate dose-value operations; After that - development of recommendations for decreasing the doses on the basis of the analysis.

- Work planning control performance for a unit outage, integrated operational schedule for one, for daily and weekly tasks. At that all outage' papers must be considered (agreed) with the expert (head) of health physics division.

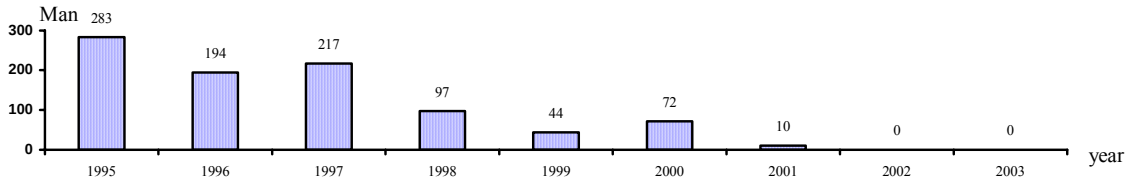
- Participation in the newly performed radiation dangerous jobs.

As a result of the activity carried out and comprehensive approach during the outage's work planning the forecasting based on the previous works analysis of division's collective dose exposure has been put into practice. Division heads were made responsible for workers' individual doses; the list of the organisation measures to decrease the dose input is being made for each planned outage.

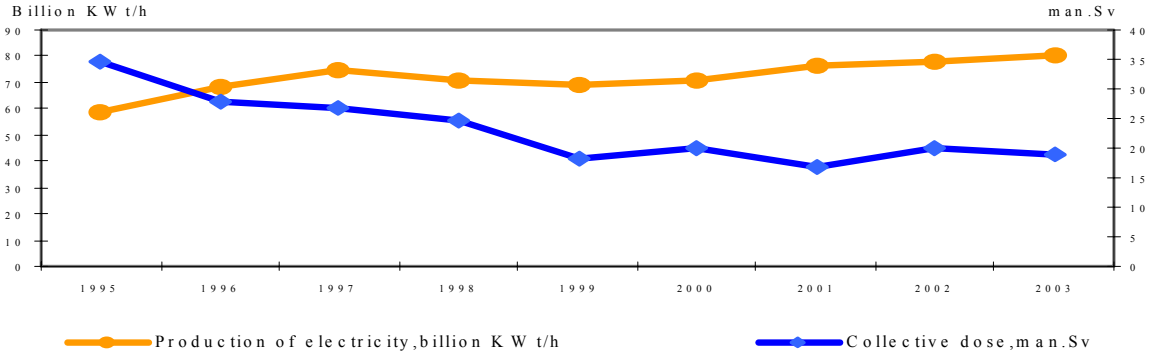
Individual and collective dose analysis in the NNEGC "EnergoAtom"

During the recent 9 years, the annual collective dose at the Company's NPPs has had the tendency to decrease.

Graph 1. The number of WWER personnel having taken the external dose more than 20 mSv per year during 1995-2003.



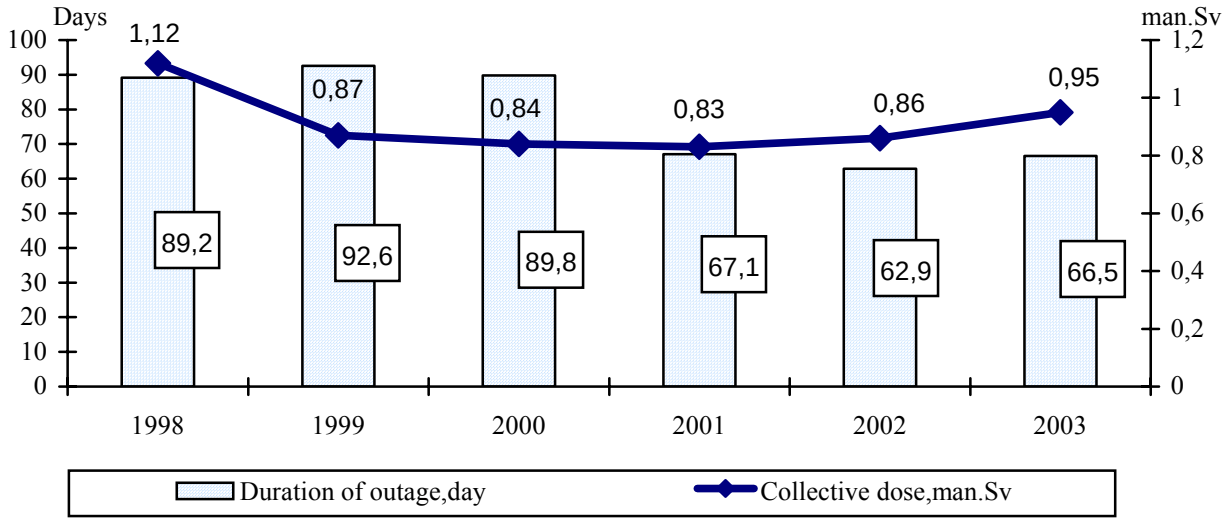
As we can see from the graph 1 during 2002 and 2003 in the Company no event of exceeding the main limit of individual dose of exposure - 20 mSv per year was recorded.



Graph 2. The trends of collective dose change and amount of electricity production in NNEGC " EnergoAtom" during 1995-2003

As we can see from Graph 2 that under a stable tendency of electricity production increase (due to a load capacity factor) by the Company during recent nine years the total value of collective dose of NPP's personnel was steadily decreasing up to 1999 and from this period has remained at the same level. So, the total collective dose exposure of NPP's personnel in 2003 was 18,8 man.Sv, that less by 1,2 man.Sv in comparison with 2002.

In Graph 3 outage personnel collective exposure doses are presented and average outage time for one unit.



Graph 3. Collective exposure dose and duration of outage per unit in NNEGC "EnergoAtom" for a period from 1998 to 2003.

The data analysis shown in the graph 3, indicates that the curve reflecting the level of outage personnel collective dose is identical to the curve of the total personnel collective dose of the Company for the recent years (see graph 2). Beginning with 1999 the level of outage dose was decreasing and for recent three years hasn't essentially changed. In 2003 due to the outage time increase per unit the collective dose per unit increase accordingly. Taking into account substantial input of outage doses (70-80%) into the total collective dose beginning with 2002,in NNEGC "Energoatom" outage doses have been planned for each unit outage.

In 2002 into NNEGC " Energoatom" completed the development of the normative document (guide) "Methodological Guidelines for the Collective Personnel Exposure Dose Analysis during Planned Outage and Equipment Maintenance Activities at NPPs" with the purpose of calculation unification of work-consuming and dose-consuming tasks for the repair and maintenance works for separate systems and separate jobs. Development of this document was based on current experience at NPPs regarding such accounting in compliance with international recommendations (adapted with ISOE).

This document entered into force by orders of both the Ministry of Fuel & Energy of Ukraine and the Company. Implementation of the "Methodological Guidelines …" must establish and promote high quality comparative analysis on the basis of experience exchange and liven up the work decreasing occupational exposure that will finally lead to improving radiation safety at NPPs.

NNEGC Board have created a section as a part of Scientific-Technical Council called "Radiation Protection and Radioactive Waste Management" where the most important issues for the different ways of activity are considered. By the end of 2003 " Program on Decreasing of NPP Staff Exposure from 2004 to 2008" was developed end entered into force in which organization and technical evolutions at each NPP and needed funds for its execution are specified.

Currently at each NPP:

- The "Lists of Radiation -Dangerous Jobs, Operational and Repair Procedures" have been developed;
- Forecasting of collective dose exposure for a unit outage has been implemented;
- Reviewing of on-going programs of radiation –dangerous works has started in concordance with "Lists of radiation-dangerous jobs, operational and repair procedures" with purpose to ensure radiation protection;
- Engineering groups (or an appointed worker) for performing the analysis and processing the information concerning division collective dose changes and major repair activities have been organized.

In that way by NNEGC "Energoatom" and its NPPs (on-site) a sufficient range of activities in the field of ensuring radiation protection and radiation safety is performed.

Problems

However at present several problems which prevent correct practical and organizational Radiation Protection aspects implementation are not resolved. The major problems involve creation/review of normative – methodological documents of the highest level and bringing the existing documents to conformity.

Currently, the same common problems connected with personnel exposure exist for all Ukraine's NPPs. Thus, the lack of modern electronic dosimeters at NPPs leads to additional mistakes during exposure dose determination and man-hour determination for separate radiation-dangerous activities.

At present a limited quantity of electronic dosimeters is available at Rivne NPP, not so long ago 300 MGP dosimeters were received at South-Ukraine NPP, the rest of NAEK "EnergoAtom" NPPs haven't got them in spite the decision taken about their purchase. In general, this is connected with their high cost and other financial problems of the Company.

Conclusions

Introduction of automatic systems of metal quality examination and control, efficient remote methods of decontamination, remote visual control means (television systems) utilization, steam generators and high-level equipment tightness control systems – these are the main means to reduce the quantity of the personnel having doses approaching the permissible and collective doses reduction.

Resolution of these problems will allow NPP radiation protection services respond adequately and in proper time to processes of collective occupational dose formation during radiation dangerous activities in time of corrective maintenance, outage. Organizational measures directed at exposure reduction isn't enough. That is why at this stage of ALARA principle introduction the attention should be focused on technical aspects of the problem solution.

ALARA principle implementation during activities at the Chornobyl state specialized enterprise and at the "Shelter".

As you know, Chornobyl NPP was shut down on December 15, 2000. The Chornobyl state specialized enterprise was created on its basis. The activity of this enterprise is directed at Chornobyl NPP decommissioning and Shelter Implementation Plan (transformation of the "Shelter" facility into ecologically safe system). In order to solve these problems "The Integrated Program of Radioactive Waste Management during Chornobyl NPP Decommissioning and Transformation of the "Shelter" Facility into Ecologically Safe System" was developed.

The main objectives of this Program are as follows:

- Preventing radioactive waste release into environment at different phases of radioactive waste management;
- Minimization of the amount of a radioactive waste arising at Chornobyl NPP and the "Shelter";
- Arisen radioactive waste reprocessing;
- Personnel exposure dose reduction during radioactive waste management.

The Program objectives have to be accomplished by means of:

- ALARA principle implementation at all stages of radioactive waste management;
- All reconstruction and modernization activities analysis in order to minimize radioactive waste arising;
- Development and implementation of new radioactive waste reprocessing technological processes;
- Personnel training in technologies of modern radioactive waste management;
- Uniform radioactive waste accounting system development.

Optimization principle utilization during the "Shelter Implementation Plan" projects development

Currently the "Shelter" Radiation Protection Program has been developed and is being agreed with the regulatory bodies. In the above Program the ALARA principle implementation for ensuring the radiation protection level during "Shelter" activities programs development could be shown.

It is necessary to systematize the basic information during "Shelter" activities programs development and if needed to perform additional research. As a result the information has to be obtained concerning:

- *Radiation sources identification and location*. To assess the level of potential exposure it is necessary to identify these radiation sources to estimate probable accidents and connected probable potential exposure during the pre-design research stage.

- *Personnel movement hindrances*. The hindrances have to be identified, defined or eliminated. These provisions have to be made during the working schedule and technological maps development. This approach envisages not only identification movement routes but measures of their development before the beginning of activities. Such activities have to be defined as preparation activities and should allow to minimize the doses absorbed by the personnel having access to places where works are performed. Besides, places which need shielding have to be defined on the maps. The shielding has to be foreseen according to the number of passages, the number of workers passing and prevented exposure dose.

- *Personnel movement routes*. The routes are to be properly defined and illuminated. During instruction activities the personnel has to learn properly not only the main routes but accident evacuation routes as well. Thus, different movement routes have to be foreseen in the design documentation; the main route as well as the additional one.

- *Radiation situation in the places where works are being performed*. Maps of γ - radiation exposure dose capacity distribution, α и β- particles surface contamination density and bulk concentration of aerosols in the air have to be obtained.

- *Work performance zones conditions concerning their illumination, space closure, etc*. Information connected with meeting the industry safety requirements influences greatly the optimization of the work performance process. Taking into account the necessity of preparation activities connected with illumination system creation also influences the collective exposure dose during work performance. Under normal illumination conditions the personnel will perform the work faster and the exposure dose will be smaller. In the work performance plan it is necessary to take such technical decisions concerning power supply and illumination system creation so that preparation of their installation in radiation dangerous places could take minimum time, and the major works could be performed in the clean zone. Space closure also plays an important role in exposure dose optimization. In such areas it is necessary to use such technologies, to use such number of people so that rigging and equipment couldn't hinder work performance; the number of people has to be minimized.

According to the information obtained it is necessary to perform the analysis of suggested technical decisions. The decisions themselves have to foresee several implementation options. Among the suggested options, the one which could allow personnel collective dose reduction ought to be chosen.

References

[1] Law of Ukraine " Nuclear Energy Utilization and Radiation Safety About " (1995).

[2] Law of Ukraine " Radioactive Waste Management About " (1995).

[3] Law of Ukraine " Protection of Man from Acting Ionizing Radiation About" (1998).

[4] Decree by Board of Governors of Ukraine "Measures for Transformation of "Shelter" to the ecological safety system" (N1561, 1996).

[5] Ukrainian Hygiene Standard "Radiation Safety Standard of Ukraine " (1997)

[6] Ukrainian Hygiene Standard "Radiation Safety Standard of Ukraine/Supplement: Protection against Potential Exposure " (2000).